Final Report
Phase II Tittabawassee/Saginaw River Dioxin Flood Plain Sampling Study

I. Executive Summary

Soil samples collected during the development of a wetland mitigation project identified elevated levels of dioxin and furan compounds (hereinafter collectively referred to as dioxin) in a farm field located near the confluence of the Tittabawassee and Saginaw Rivers. The samples, collected during April 2000, identified concentrations of dioxin as high as 2,200 parts per trillion (ppt) toxic equivalents (TEQ). The dioxin concentration was nearly 25 times the residential direct contact criterion (RDCC) of 90 ppt TEQ established under Part 201, Environmental Remediation, of the Natural Resources and Environmental Protection Act, 1994 PA 451, as amended (Part 201). The Part 201 RDCC of 90 ppt is the concentration of dioxin in soil determined to be safe for direct contact from residential exposure. Concern over the public and environmental health implications of these sample results prompted the Department of Environmental Quality (DEQ), Remediation and Redevelopment Division (RRD), to develop and implement a phased soil sampling and assessment program in the Tittabawassee River flood plain to determine the source and extent of the contamination.

Summary - Phase I

The Phase I portion of the soil sampling program was implemented during the period December 2000 through July 2001. The RRD collected 34 soil samples from five locations within a two-mile stretch of the Tittabawassee River flood plain between Center Road in Saginaw Township, Saginaw County, and the Saginaw River confluence. The Phase I sample locations are identified in Map 1. Soil samples were collected at depths ranging from the ground surface to 15 inches below ground level (bgl). Analytical results identified concentrations ranging from 35 to 7,300 ppt TEQ. Only 7 of the 34 samples contained dioxin TEQ concentrations less than the Part 201 RDCC (90 ppt TEQ). A summary of Phase I TEQ sample results is presented in Table 1. The Phase I individual dioxin congener results are presented in Appendix G.

Map 1: Phase I Sampling - - Tittabawassee/Saginaw River Flood Plain

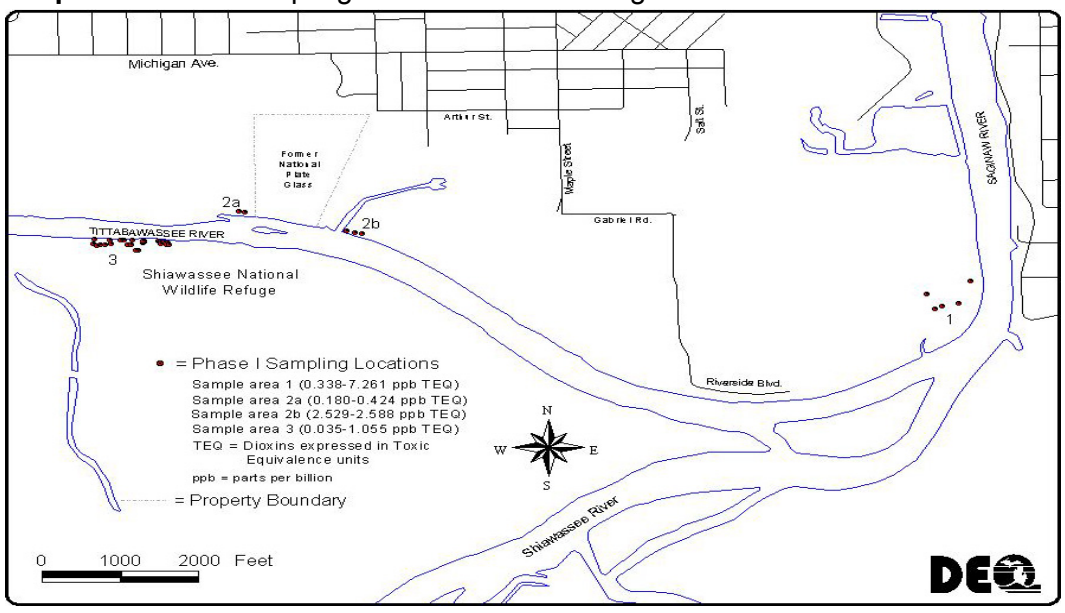


Table 1
Greenpoint-Tittabawassee River Dioxin/Furan Study Area
Phase I Sampling Study

Samples were analyzed by Triangle Laboratory, Durham, NC using US Environmental Protection Agency/USEPA Method 8290. All sample results are reported in pg/g (ppt) TEQ using USEPA Toxic Equivalency Factors (TEF) 1989

General Motors (GM) farm field (GM collected composite surface soil samples from the farm field) April 2000	
E3A	1,500
C1A	2,200

GM farm field (RRD collected discrete surface soil samples from farm field to verify April 2000 results) December 2000	
DX#1	390
DX#2	7,300
DX#3	6,300
DX#4	3,600
DX#5	340

LA Davidson (RRD collected discrete surface soil samples) May 2001	
From the farm field west of the LA Davidson site	
DX1 west	410
DX2 west	180
*From the golf course east of the LA Davidson site	
DX3 east	2,600
DX4 east	2,500

US Fish and Wildlife Service (USFWS) Shiawassee Wildlife Refuge (RRD collected discrete soil samples from wooded area) May 2001			
approximately < 6" bgl (below ground level)		approximately < 12" bgl	
GP1-6	39	GP1-12	58
GP2-6	130	GP2-12	360
GP3-6	59	GP3-12	57
GP4-6	35	GP4-12	160
GP5-6	130	GP5-12	1,100

USFWS Shiawassee Wildlife Refuge (RRD collected discrete soil samples from upland, open area) June 2001					
0 - 3" bgl		3 - 6" bgl		12 - 15" bgl	
SS1-3	390	SS1-6	590	SS1-12	58
SS2-3	770	SS2-6	420	SS2-12	280
SS5-3	390	SS5-6	540	SS5-12	250
SS6-3	590	SS6-6	550	SS6-12	110
SS7-3	490	SS7-6	660	SS7-12	68

DEQ residential direct contact criterion = 90 ppt (expressed as an equivalent concentration of 2,3,7,8-TCDD (TEQ))

The Phase I final report was completed during October 2001. The following determinations were presented in the final report:

- Elevated concentrations of dioxin were confirmed within the lower Tittabawassee River flood plain near the river's confluence with the Saginaw River.

- Dioxin concentrations were consistently found above the Part 201 RDCC (90 ppt TEQ), and were identified as high as 80 times the Part 201 RDCC.

- Human use of the flood plain increases upstream of the Phase I sample area. Residential properties are located within the flood plain, the majority located within the Shields area of Thomas Township and Saginaw Township. Public park lands and agricultural operations are also located within the flood plain.

- A Phase II sampling program was recommended to further evaluate the extent of contamination above the Part 201 RDCC occurring within the flood plain upstream of the Phase I sample area.

Summary – Sediment Study

The DEQ collected and analyzed Tittabawassee River sediment samples during spring/ summer 2001, as part of the Baseline Characterization of Saginaw Bay Watershed Sediment Study (DEQ Sediment Study). The objective of the DEQ Sediment Study was to provide baseline concentrations of contaminants in Tittabawassee River sediments both upstream and downstream of the city of Midland (Midland). Dioxins and furans were analyzed as part of this study. Surface sediment samples were collected from the Chippewa River, Pine River, and Tittabawassee River beginning immediately upstream of Midland and continuing downstream to the beginning of the Saginaw River. Sediment cores were collected and analyzed in select areas. Some flood plain soil samples were also collected for analysis. Sample locations and results are presented in Appendix H.

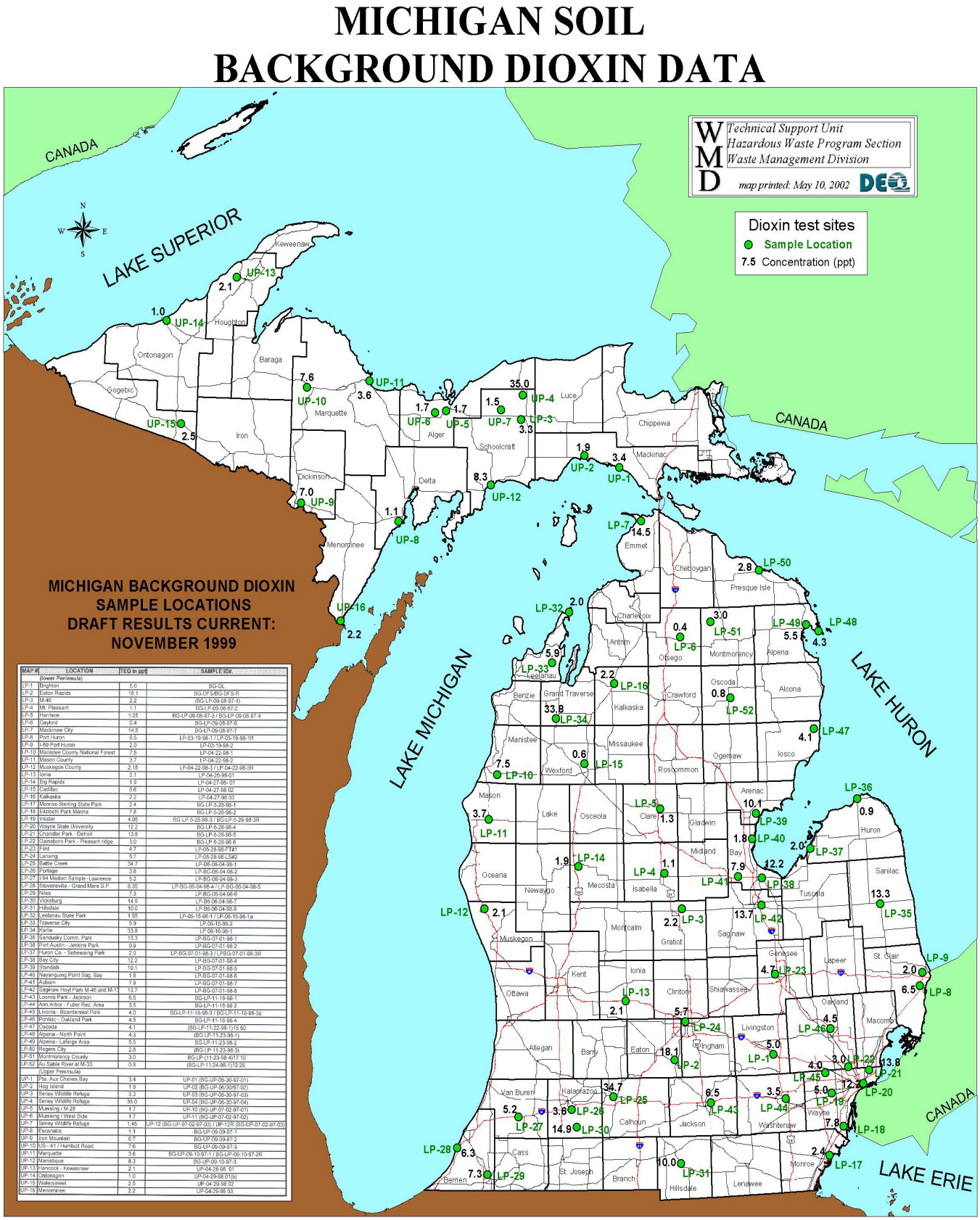
The DEQ Sediment Study final report was completed and distributed during the summer of 2002. The study results presented in the final report indicate the following:

- Dioxin concentrations from sediment and flood plain soil sample locations upstream of Midland are consistent with the average dioxin concentration in soil samples collected statewide from areas where there are no known dioxin release source(s) (hereinafter referred to as statewide background, see Figure 1).

- Dioxin is present at elevated concentrations in sediment and flood plain soil samples collected downstream of Midland. The extent of contamination is pervasive throughout the study area downstream of Midland. Sediment contamination ranged up to 2100 ppt TEQ and was present to the downstream limit of the study area, approximately 20 miles downstream of Midland. All flood plain soil samples collected downstream of Midland exceeded the Part 201 RDCC with concentrations ranging between 300 and 1500 ppt TEQ.

- The variability of dioxin concentrations in river sediment samples is believed to be a result of the variability of river water flow and site-specific sediment deposition characteristics.

Figure 1: Michigan Soil Background Dioxin Data



MAP #	LOCATION	TEQ in ppt	SAMPLE ID#.
	(lower Peninsula)		
LP-1	Brighton	6.0	BG-GL
LP-2	Eaton Rapids	18.1	BG-DFS/BG-DFS-R
LP-3	M-60	2.2	(BG-LP-09-08-97-1)
LP-4	Mt. Pleasant	1.1	BG-LP-09-08-97-2
LP-5	Harrison	1.25	BG-LP-09-08-97-3 / BG-LP-09-05-97-4
LP-6	Gaylord	0.4	BG-LP-09-08-97-6
LP-7	Mackinaw City	14.5	BG-LP-09-08-97-7
LP-8	Port Huron	6.5	LP-03-19-98-1 / LP-03-19-98-1R
LP-9	I-69 Port Huron	2.0	LP-03-19-98-2
LP-10	Manistee County National Forest	7.5	LP-04-22-98-1
LP-11	Mason County	3.7	LP-04-22-98-2
LP-12	Muskegon County	2.15	LP-04-22-98-3 / LP-04-22-98-3R
LP-13	Ionia	2.1	LP-04-26-98-01
LP-14	Big Rapids	1.9	LP-04-27-98- 01
LP-15	Cadillac	0.6	LP-04-27-98 02
LP-16	Kalkaska	2.2	LP-04-27-98 03
LP-17	Monroe-Sterling State Park	2.4	BG-LP-5-28-98-1
LP-18	Elizbeth Park Marina	7.8	BG-LP-5-28-98-2
LP-19	Inkster	4.95	BG-LP-5-28-98-3 / BG-LP-5-28-98-3R
LP-20	Wayne State University	12.2	BG-LP-5-28-98-4
LP-21	Chandler Park - Detroit	13.8	BG-LP-5-28-98-5
LP-22	Gainsboro Park - Pleasant ridge	3.0	BG-LP-5-28-98-6
LP-23	Flint	4.7	LP-05-28-98-FT#1
LP-24	Lansing	5.7	LP-05-28-98-LS#2
LP-25	Battle Creek	34.7	LP-BE-06-04-98-1
LP-26	Portage	3.6	LP-BG-06-04-98-2
LP-27	I-94 Median Sample - Lawrence	5.2	LP-BG-06-04-98-3
LP-28	Stevensville - Grand Mere S.P.	6.35	LP-BG-06-04-98-4 / LP-BG-06-04-98-5
LP-29	Niles	7.3	LP-BG-06-04-98-6
LP-30	Vicksburg	14.9	LP-BG-06-04-98-7
LP-31	Hillsdale	10.0	LP-BG-06-04-98-8
LP-32	Leelanau State Park	1.95	LP-06-15-98-1 / LP-06-15-98-1a
LP-33	Traverse City	5.9	LP-06-15-98-2
LP-34	Karlin	33.8	LP-06-16-98-1
LP-35	Sandusky Comm. Park	13.3	LP-BG-07-01-98-1
LP-36	Port Austin - Jenkins Park	0.9	LP-BG-07-01-98-2
LP-37	Huron Co. - Sebewaing Park	2.0	LP-BG-07-01-98-3 / LP-BG-07-01-98-3R
LP-38	Bay City	12.2	LP-BG-07-01-98-4
LP-39	Standish	10.1	LP-BG-07-01-98-5
LP-40	Nayanguing Point Sag. Bay	1.8	LP-BG-07-01-98-6
LP-41	Auburn	7.9	LP-BG-07-01-98-7
LP-42	Saginaw Hoyt Park M-46 and M-13	13.7	LP-BG-07-01-98-8
LP-43	Loomis Park - Jackson	6.5	BG-LP-11-18-98-1
LP-44	Ann Arbor - Fuller Rec. Area	3.5	BG-LP-11-18-98-2
LP-45	Livonia - Bicentennial Park	4.0	BG-LP-11-18-98-3 / BG-LP-11-18-98-3d
LP-46	Pontiac - Oakland Park	4.5	BG-LP-11-18-98-4
LP-47	Oscoda	4.1	(BG-LP-11-22-98-1)15.50
LP-48	Alpena - North Point	4.3	(BG-LP-11-23-98-1)
LP-49	Alpena - Lafarge Area	5.5	BG-LP-11-23-98-2
LP-50	Rogers City	2.8	(BG-LP-11-23-98-3)
LP-51	Montmorency County	3.0	BG-LP-11-23-98-4/17.10
LP-52	Au Sable River at M-33	0.8	(BG-LP-11-24-98-1)12.25
	(Upper Peninsula)		
UP-1	Pte. Aux Chenes Bay	3.4	UP-01 (BG-UP-06-30-97-01)
UP-2	Hog Island	1.9	UP-02 (BG-UP-06-30/97-02)
UP-3	Seney Wildlife Refuge	3.3	UP-03 (BG-UP-06-30-97-03)
UP-4	Seney Wildlife Refuge	35.0	UP-04 (BG-UP-06-30-97-04)
UP-5	Munising / M-28	1.7	UP-10 (BG-UP-07-02-97-01)
UP-6	Munising / West Side	1.7	UP-11 (BG-UP-07-02-97-02)
UP-7	Seney Wildlife Refuge	1.46	UP-12 (BG-UP-07-02-97-03) / UP-12R (BG-UP-07-02-97-03)
UP-8	Escanaba	1.1	BG-UP-09-09-97-1
UP-9	Iron Mountain	0.7	BG-UP-09-09-97-2
UP-10	US - 41 / Humbolt Road	7.6	BG-UP-09-09-97-3
UP-11	Marquette	3.6	BG-UP-09-10-97-1 / BG-UP-09-10-97-2R
UP-12	Manistique	8.3	BG-UP-09-10-97-3
UP-13	Hancock - Keweenaw	2.1	UP-04-28-98 01
UP-14	Ontonagon	1.0	UP-04-29-98 01(a)
UP-15	Watersmeet	2.5	UP-04-29 98 02
UP-16	Menominee	2.2	UP-04-29-98 03

Summary – Phase II

A Phase II flood plain soil sampling program (Phase II) was developed based on the results of the Phase I Report and the DEQ Sediment Study. Flood plain soil samples were collected from the Chippewa, Pine, and Tittabawassee Rivers upstream of Midland, and at specific locations along the Tittabawassee River downstream of Midland to the beginning of the Saginaw River. Phase II soil samples were collected and analyzed during the period from May through December 2002 from the locations shown (see Figure 2). Initial observations of the Phase II sample results identified the following:

- The majority of flood plain soil sample dioxin concentrations downstream of Midland exceed the Part 201 RDCC, indicating that dioxin contamination of flood plain soil downstream of Midland is pervasive.

- Flood plain soil samples collected upstream of Midland contain dioxin concentrations consistent with statewide background concentrations.

- Dioxin concentrations from sample locations located downstream of Midland, but outside the estimated 100-year flood plain, are consistent with statewide background concentrations.

- The deepest initial Phase II soil sample (12-15 “) did not define the vertical extent of dioxin contamination. Soil samples were analyzed from three deep soil borings collected from Freeland Festival Park to improve understanding regarding the vertical extent of dioxin contamination. These additional samples indicate that dioxin contamination above statewide background concentrations exist at the park to a depth of four feet bgl. Additional deep soil sampling is necessary to determine if this vertical distribution of dioxin is consistent throughout the flood plain.

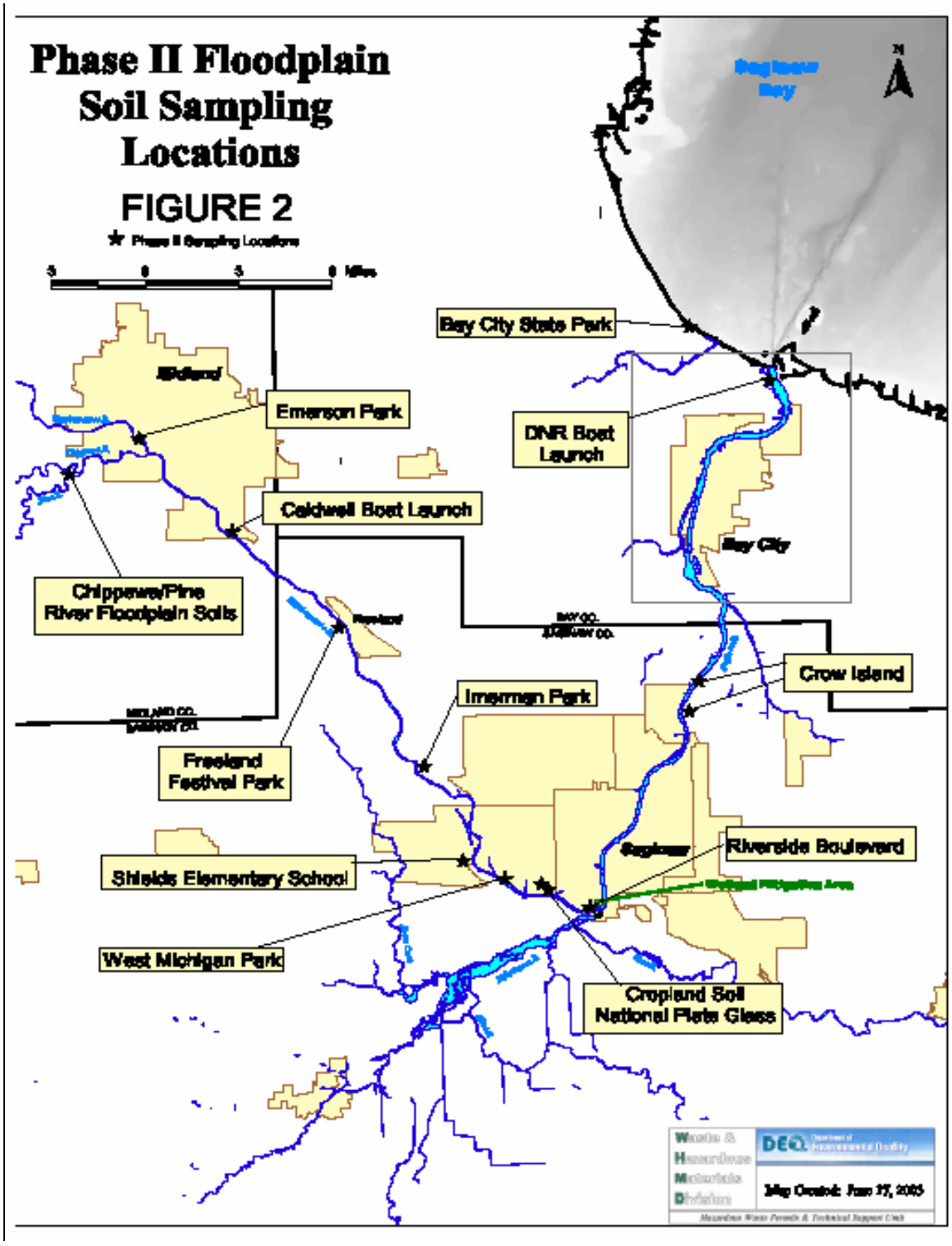
- The concentration of co-planar polychlorinated biphenyl (PCB) compounds represents an insignificant contribution to the total dioxin-like toxicity at all Phase II sample locations.

- Eggs from chickens that free range on flood plain soil exhibit elevated concentrations of dioxin. It is possible that food products from other animals raised on the flood plain could be affected.

- Dioxin concentrations in flood plain drinking water well samples were not determined to exceed applicable regulatory criteria.

- Saginaw River and Saginaw Bay navigation channel sediment samples collected in 1999 by the U.S. Army Corps of Engineers (USACE) indicate that dioxin contaminated sediment from the Tittabawassee River has migrated into the Saginaw River and the inner portions of the Saginaw Bay. Initial soil samples collected by the RRD from the Saginaw River and Saginaw Bay shoreline areas appear to confirm these results, though additional sampling of these areas is needed.

Figure 2: Phase II Soil Sampling Locations



The remainder of this report provides a detailed presentation of Phase II sampling objectives, methodology, sample results, congener profile characterization, conclusions, and recommendations.